

EXHIBIT 1

From: Gnagy, Marvin [marvin.gnagy@veolia.com]
Sent: Friday, February 27, 2015 4:17 PM
To: Nicholas, Robert
Subject: Re: Flint Report
Attachments: Final Report (V2) mcg edits.docx

Edited document attached. Contact me with any questions.

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On Fri, Feb 27, 2015 at 1:33 PM, Nicholas, Robert <robert.nicholas@veolia.com> wrote:
Here you go

I put in yellow figures mg/l and \$ that need help. And no I am not smart enough to pull the right numbers off the bench test and graphs.

Also I put text down which hopefully captures what we have talked about but not sure.

If you can spin it back then I will get Paul to edit from his standpoint looking for stuff the press will grap onto.

We could also put all your bench test sheet, graphs in an appendix on the back in an appendix.

--

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March 4, 2014

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FROM
Veolia Water

TO
Emergency Manager Gerry Ambrose

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Assignment

This report will provide the findings requested by the City in regards to the operation of the water plant, distribution system, customer service and communication, capital plans and actions as well as the budget.

The urgency of the water quality problems and intense public interest make it important to remind the City the scope involved a one week assessment of the ~~situation-current operations~~ by four people. The product from that effort is to be a letter or ~~power-point~~ presentation reviewing the actions taken by the City to date, validating the City's plans going ~~forward~~ plus making any recommendations for ideas not being considered and a schedule for what might be done. It our desire to help the citizens and public officials, but ~~we~~ do want to remind all that our effort was asked to be limited in scope.

Actions Taken to Date

The City has reacted to the ~~water quality problems~~ by making changes in how the system is operated, sought help from the State, hired an engineer Lockwood, Andrews & Newnam, Inc. (LAN) to provide additional advice and now hired Veolia for operating advice. Those seem logical actions to be taken ~~in under~~ the circumstances.

The Michigan Department of Environmental Quality (MDEQ) has requested specific actions in regards to the TTHM issues. The report from LAN indicates apparent reasons for the TTHM problem. These generally relate to high Total Organic Carbon (TOC) in the water source, improperly operating equipment both in the plant and the distribution system, less than optimal plant TOC removal and old cast iron pipe in the distribution system. Those problems seem likely given what is been observed in our visit.

Flint is not alone in its problems of dealing with TTHM problems. Many utilities across the country are facing this challenge and the City appears to be following the logical steps many of those communities are taking to correct the problem.

Although the primary focus of this review was based on solving the TTHM problem, the public has expressed its frustration and anger over discolored water and hard water. Those aesthetic issues ~~actually have~~ created a general concern by the public about the safety of the water. The review of the records for the time of the study shows the water to be in compliance with State and Federal regulations. As such that water is deemed ~~safe as meeting~~ drinking water requirements in those terms. Public fear of other chemicals ~~they feel might be in the water~~ or other

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water quality problems was not in our scope of work. The City ~~however does appear~~ ~~however~~ to be proactive in its efforts to reach out to the medical community, ~~to~~ set up a phone number and email address to receive complaints, ~~to~~ post State Water Quality reports, ~~to~~ provide the list of EPA required water tests, ~~and also to~~ offer to test the water at anyone's ~~household~~ who has a concern. The City is trying to be transparent and responsive beyond what many other communities might do.

Plans for Moving Forward

The City is using LAN Engineering to provide technical assistance and prepare required reports for the State triggered by the ~~previous~~ TTHM levels. In addition the City has reached out to different specialty vendors (chemical suppliers, filter companies and tank aeration companies) of products to help with the TTHM issues. LAN in their February 20th Operational Evaluation Report TTHM Formation Concern indicates the steps planned and underway.

Primary Suggestions

- **Hire a Third Party Water Quality Expert to Complete Independent Audit** – This report from Veolia is part of that effort.
- **Obtain a THM Analyzer** – This was a good decision has been received at the plant. A TOC analyzer would be another practical addition at this time in helping to optimize chemical dosages by determining TOC removal effectiveness of each plant unit.
- **Carry Out Jar Testing** – Jar testing was performed on the use of potassium permanganate, ferric ~~chloride~~, lime and other chemicals to determine the most effective chemicals and dosages. The staff understands the ~~basic treatment process~~, but needs further practice and ~~training~~ to become proficient in the use of ~~routine process control~~ regularly to adjust water quality.
- **Water Plant Optimization Softening** – The softening process was being by-passed at different times of the past year for malfunctioning equipment. The function of that equipment continues to be a problem because of ~~ineffective flow splitting capabilities and~~ unbalanced equipment and feed problems with the lime equipment. Some changes are being made, but the equipment is old and in need of replacement. ~~The softening~~ is only needed for the use of river water. There is the potential to feed soda ash, which can improve the process slightly, but would have a major impact on costs.
- **Water Plant Optimization Disinfection of Filter Beds** – This needs to be thought through carefully. One technique for use in warm weather is to not pre-chlorinate the filters. This delays the introduction of chlorine until after maximum TOC removal in the plant. The introduction of ~~Granulated Granular Activated Carbon (GAC)~~ as well would make this problematic causing premature ~~filter exhaustion~~ of the GAC.
- **Water Plant Optimization Polymer Aid to Coagulation and Flocculation** – A bench test evaluation of multiple products determined that an increased dosage of ~~either ferric ferric chloride or aluminum chloride~~ was the most effective addition.
- **Increase Water Main Flushing** – This effort is underway, but we have not seen ~~either~~ a formalized plan, ~~nor a~~ review of results and techniques. The up-dated hydraulic model is planned to be used in refining the flushing locations. This flushing should be focused on areas of high ~~water~~ ~~age~~ for the most effective flushing ~~location impacts~~.

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- **Water Modeling Cedar Street Pump Recirculation** – Veolia did not look at that action.
- **Water Modeling West Side Pump Recirculation** – Veolia did not look at that action.
- **Broken Valve Locations** – LAN has indicated the hydraulic model has been up-dated with known broken valve locations and with that added information the model is being used to find other system problems. No information was provided to Veolia on locations of the broken valves. If these are ~~in locations~~ in areas of old water age, it would be important to prioritize future valve turning and to repair ~~to~~ those valves.
- **Increase Flushing** – The hydraulic model should be used to help identify the best location to flush areas of oldest water age.

Contingent Actions

Should the primary actions not provide ~~the desired results~~, other options are to be considered.

- **Fix Ozone System** – The gauges and programing has been completed per the LAN report. Additional minor repairs are planned this year.
- **Start Feeding Coagulant and Flocculation Polymer** – The use of ~~either ferric chloride or aluminum chlorohydrate has have~~ demonstrated through bench testing to be ~~just as~~ the most effective as ~~other chemicals for TOC removal~~. The tests of other products did not for either Veolia or LAN produce better results. ~~TOC reduction also appears to improve with increased dosing.~~
- **Convert to Lime and Soda Ash Softening** – The use of soda ash can be effective, but installation of a permanent feed system is costly. ~~Use of caustic soda (sodium hydroxide) was evaluated in the bench scale testing, but did not produce significant improvements in hardness reductions.~~
- **Change Disinfection to Chloramine or Chlorine Dioxide Temporarily** – This can be in some cases an effective method of disinfection to reduce TTHM. It ~~however, from~~ requires coordination with other utilities to so that disinfection products are compatible if water is mixed. It should be noted the City Council expressed concerns about the use of ammonia in the water. A change temporarily to chloramines would be rather complex and difficult to carry out, ~~changes to it and Once on lake water, chloramines would need to be changed again, then back to chlorine.~~
- **Install Pre Oxidant at Intake** – The use of ~~either potassium permanganate or sodium permanganate~~ will assist in reducing ozone feed levels. The levels of ozone were rising to a point that potential bromate violations could occur if not carefully monitored. The use of ~~potassium either permanganate chemical~~ will help minimize that problem.
- **Replace Filter Media** – The use of ~~Gemulated (Granular)~~ Activated Carbon (GAC) is a good idea and will improve the TOC removal. This change will however require other changes in operations like reducing pre chlorination of the filters ~~which that~~ can reduce the GAC effectiveness causing early replacement. The GAC also needs to be monitored for its effectiveness, which diminishes over time requiring replacement.
- **Implement Advanced Treatment** – ~~not sure I know how to explain this to a layman installation of other treatment processes specifically targeted for TOC removal could be done at the treatment plant. These advanced systems, though, are costly to construct and to operate. Advanced systems for increased TOC removal could include GAC contactors, anion exchange contactors, or membranes.~~

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- **Increase Main Flushing** – Discussed above this needs to be continued, but in a planned well thought out manner. This includes notifying residents in neighborhoods about what is occurring. Crews doing the flushing are trained to explain to the public what they are doing to the public. Keeping records of the time to clear the line of color. When the cleaning is done so a frequency can be established.
- **Continue Valve Replacement** – The testing and replacement of valves should be focused on the areas with the longest water age.
- **Emphasizes Cast Iron Pipe Replacement** – This effort is focused first on a 3-mile section of 24-inch pipe this coming construction season.

Veolia Recommendations

Many of the recommendations made by Veolia match what LAN has proposed in their report. The difference is that Veolia has approached the project from the point of view of an operator and utility manager. This assures the City of a well-rounded review of the situation and a more comprehensive solution to the problem.

- **Addition of Potassium Permanganate** – The addition of potassium permanganate chemical will help reduce ozone demand as well as chlorine demand. The reduction of ozone is needed to help eliminate the possibility of violating the bromate limit. The addition of the chemical will require state approval, submission of design documents for approval, procurement of the equipment and installation. The State has indicated they will work with the City on expediting any review and approval of any changes requested. The addition of potassium permanganate is estimated to be a range of ~~0.5~~ 0.5 mg/L to ~~1.2~~ 1.2 mg/L with a corresponding price of ~~\$150,000 to \$320,000~~ \$150,000 to \$320,000 per year. (Please note – The water in the river is dynamic meaning it will change with weather, seasons and other factors. The estimates provided were based on bench testing at the particular time and as such require the operators to test water and to verify chemical dosages frequently.)
- **Reduction of Ozone Feed** – Treating water is a delicate balance so that increasing ozone to fix the TTHM problem can have a different effect of raising bromate levels to a point of violation. The introduction of potassium permanganate is being made to reduce the demand for ozone so that ~~settings feed rates~~ settings feed rates will not exceed 5 mg/L. The current dosing has been as high as 8 mg/L and as such and if kept there will pose the risk of violating the bromate levels.
- **Increase of Ferric Chloride** – ~~Three~~ Four coagulant aids were tested (~~Ferric Chloride~~ Ferric Chloride, Ferric sulfate, polyaluminum chloride (PACl) and aluminum chlorohydrate (ACH). ~~Either Ferric chloride or ACH were found~~ ~~continued~~ to be the best choice of product for effectiveness in removing TOC, the precursor to TTHM formation. The current dosages being used at the plant are too low and ~~a~~ dosages of 100 mg/L or more are suggested. Again, please note, that the amount of chemical needed changes with the nature of the river and as such must be tested daily. This change to 100 mg/L is twice what is currently being fed and much higher than what had previously been fed last year. The increase ~~will~~ in chemical costs could be up to \$1,000,000 per year. This change in dosage (using ferric chloride) can be made immediately without state ~~approval~~ permit review.
- **Reduction of Lime** – Lime is currently being overfed. A higher dosage of lime does not necessarily mean better treatment. A review of different dosages with jar testing indicates that the ~~current~~ dosage of ~~200~~ 200

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- mg/L can be reduced to ~~44-220~~ **40** mg/L. This represents a potential range of savings of ~~\$200,000 per year~~ **\$200,000 per year**. This change can be made immediately. It should be noted that the current softening equipment is in poor condition, which does complicate the treatment process with a poor balance of flow between the two basins, weirs which are not level causing bypassing with the softener basins, and simply old mechanical equipment that periodically breaks down. This equipment is not going to be needed when a change to lake water occurs. ~~Please to say something about code ash.~~ Addition of soda ash to help further reduce hardness in cold weather might require dosages up to 40 mg/L with an annual chemical cost up to \$220,000. There have also been some questions or complaints from the public regarding hard water. The water entering the plant is currently ~~44-220~~ **40** mg/L and the plant is reducing that level of hardness to ~~44-220~~ **40** mg/L. Optimization of the dosage can reduce the hardness further to ~~44-220~~ **40** mg/L. This reduction however has been sporadic as equipment breakdowns and high flows have caused problems keeping the softening process on line. As we have noted before the dosage needs to be adjusted daily or more often based on ~~in-plant process control monitoring~~. The raw water hardness in the summer is much less than in the winter. For illustration purposes the difference could be ~~44-220~~ **40** mg/L in raw water in winter compared with ~~44-220~~ **40** mg/L in the summer.
- **Eliminate Pre Chlorination on the Filters** – The reduction of pre-chlorination on the filters during the summer months can help reduce TTHM formation. This action has to be carefully thought out, documented what the procedure will be and reviewed for engineering principles. As such it will take time for the design engineer to determine what could be done to assure the proper chlorine contact time and document that other safety protocols in water are not violated. This requires state approval. Any submission of this action should be considered along with a possible change in filter media. If GAC is installed then the pre-chlorination would be stopped or drastically reduced because of the chlorine impact on the GAC filter media.
 - **Change Filters to GAC** – The object of the other changes being made is to reduce the TOC before chlorine is added into the process. The plant by design is limited on the amount of TOC removal possible. A maximum removal of only 60% is likely if the plant is properly optimized. (may insert that reduction chart) The change of filter media to GAC would provide the best reduction possible and provide better than 90% removal dramatically reducing the potential for TTHM formation and thus assuring compliance with that parameter for the water system. The change in filter media, however, is complicated requiring approval by the state, design of the changes, procurement of the media and a contractor to install it. That will take time and is likely in a range of \$1.5 million or more in cost. The use of GAC also requires more testing and monitoring of the media and the TOC than with the current media. GAC will build up TOC and begin to become ineffective after a period of time. Depending upon how high the TOC that reaches the filters this could be as short as 3 months and as long as 6 months. The amount of TOC is dependent upon the river water quality and operation of the other plant processes. Once the ability of the filters to remove TOC is reached the GAC media has to be replaced.
 - **Corrosion Control** – The primary focus of this study is to assure compliance with the TTHM limits. That is not the only problem facing customers and the utility though. Many people are frustrated and naturally concerned by the discoloration of the water with what primarily appears to be iron from the old unlined cast iron pipes. The water system ~~can~~ **could** add a polyphosphate to the water as a way to minimize the amount of discolored water. ~~Polyphosphate addition can will not make a discolored water issues go away.~~ The system has been experiencing a tremendous number of water line breaks the last two winters. Just last

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week there were more than 14 in one day. Any break, work on broken valves or hydrant flushing will change the flow of water and potentially cause discoloration.

- **Eliminate a Tank** - The water system has more storage than it requires when you look at the overcapacity of the water lines and all the tanks. The City has already employed LAN to update the hydraulic model. The hydraulic model should be used to help determine if water levels can be lowered further and even to remove some tanks from service. That decision may need to be made seasonally. For example demand during the breaks last week required extensive amounts of water. The excess storage is more a problem for the system in summer than winter.
- **Prioritize Valve Replacement** - The hydraulic model shows long water age in portions of the system ~~which~~ ~~that~~ appear to be contributing to the TTHM problems. The City has a contract for valve turning and repair to find broken valves that may be closing off the flow. This contract should be focused on those sections with old water age. This activity however must wait until warmer weather in fear of making even more problems in the water system with lines freezing.
- **Target and Increase Flushing** - Flushing the fire hydrants can be useful in cleaning out lines and minimizing discolored water complaints and also helping reduce the age of water. This DOES NOT mean just opening hydrants. The hydraulic model needs to be used to determine which hydrants should be opened and for how long to assure the lines are properly cleaned. This for example might be 15 minutes or even ~~several~~ ~~hours~~ depending on location. The flushing of hydrants also needs to include records of hydrant condition, color of water initially and after periodic increments, ~~and chlorine residuals~~. All of that information will help provide information to the engineers on the effectiveness of the procedure. Each crew doing the work should be trained to help explain the process to the public and also warn neighborhoods about flushing so that staining laundry can be avoided.
- **Change to Lake Water** - The changes being made now to the water plant will not be the same changes required to treat lake water once it becomes available. A thorough analysis and plan needs to be made in preparation of that switch. This is going to need to include changes in how the plant is operated like eliminating lime softening and also in the dosages being made in different equipment.
- **Operating Programs** - All of the changes discussed above are based on testing and techniques proposed by engineers and skilled operators of ~~both~~ LAN and Veolia. The staff will need further training and implementation of detailed protocols to successfully implement the changes and ~~to~~ assure long-term success at the plant. This means the City needs to implement a series of programs to assure success in these changes.
 - **Process Control Management Plan** - The amount of testing and resulting changes in chemical dosages along with monitoring the impact on the water will require a well-documented process that all operators follow. This is commonly referred to as a PCMP and is used as a standard operating procedure so that the operators on the day shift can communicate with the night shift, that operators are following the same treatment plan for water, that the adjustments are unified between different shifts and different people, that a desired water treatment quality is defined and variations from it signal alarms and that the staff knows what to do when the water quality begins to drift away from its desired quality.
 - **Lab QA/QC** - The operation of the water plant is dependent upon accurate lab results. A standard operating procedure needs to be set and lab technicians trained in that process. EPA and the State set procedures and standards to be met and the staff should strive to meet ~~of those~~ those

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standards. The City has already purchased a TTHM analyzer but should also consider a TOC analyzer ~~which that~~ can be an online continuous device to provide immediate information on influent and effluent levels of TOC. Part of the lab records should be historical review of data to help operators better understand the changes they make in the plant.

- o **Maintenance Management** – The key to water equipment is having all the equipment ~~properly maintained~~ effectively maintained and functioning properly. The current capital program is fixing many broken pieces of equipment and updating the plant to current standards. This however must be followed with a rigorous maintenance program that assures the proper preventive maintenance, is able to predict when maintenance is needed to keep equipment functioning properly and ~~then~~ responsive to changes in flows and source water quality.
- o **Training** – The changes being suggested are new to the staff and as such training needs to be provided in what the changes involve, why they are being ~~done~~ made, the impact on the water quality, and how best to run the plant.

(insert communication actions)

A Schedule for Further Action

(I will re iterate the timing discussed above between immediate, several months for state approval and then the GAC)

Results Expected

The real question is what changes can be expected from these results in lowering the TTHM, improving the aesthesis and preparing for the change to lake water.

- **TTHM** – The City has already made great strides in reducing the TTHM levels with the changes already made. The additional suggestions by Veolia will further reduce TTHM in the water and help get the city released from the notices being provided to customers.
- **Hardness** – The hardness entering the plant this winter is 360 ~~ppm~~ mg/l, with the current system reducing it to 300 ~~ppm~~ mg/l and optimization will reduce to ~~about 100 mg/l~~ about 150 mg/l. During the summer the levels will be lower probably in the 140 mg/l to 160 mg/l range ~~150 mg/l range~~. The target is 100-120 mg/l to 150 mg/l.
- **Discolored Water** – The discolored water is caused by the old unlined cast iron pipe. The water from the plant can have an impact on discolored water, but a greater concern is the breaks, hydrant flushing and construction work ~~when that~~ disrupts the flow of water causing discoloration. A: poly phosphate is suggested to help bind the old cast iron pipe reducing instances of discolored water, BUT WILL NOT eliminate discolored water occurrences.
- **Chloride Levels** – GM concern
- **Ammonia Level and Addition** – Council concern

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- **Lead and Copper** – A public notice was provided in December of testing and residents interested in having their water tested. The results show levels below ~~regulations~~regulated limits. Medical Concerns – Veolia suggests that any medical concern a person has be directed to their family doctor or ~~to~~ the health department. The City is communicating with the medical community and should continue as well as with MDEQ.
 - **Testing** – Many people have asked about what tests are run. The list of ~~Primary and Secondary tests~~current drinking water standards is provided in the appendix. The secondary standards are simply reporting and no ~~standards enforcement requirements~~ are set. There seems to be concerns for other chemicals not tested. The City can test for those contaminants if residents can pinpoint their concern ~~and if a test method currently exists for a contaminant of concern~~. A list of additional chemicals is ~~provided provided~~ that EPA is considering now for inclusion in ~~setting the drinking water standards~~. The City is already offering to test individual's water and should continue. It might be good to post those results.